REMARKS

Reconsideration of this application, as amended, is respectfully requested.

Claims 1, 3, 5-17, 19, 26-28, 30 and 31 are pending. Claims 1, 3, 5-17, 19, 26-28, 30 and 31 stand rejected.

Claims 1 and 10 have been amended. Claims 14, 28, 30, and 31 have been cancelled. Support for the amendments is found in the specification, the drawings, and in the claims as originally filed. Applicants submit that the amendments do not add new matter.

Verification of the claimed subject matter

Applicant discloses on page 10, paragraph 28 in the specification that the total weight fusible filler can be in the range of approximately 60-90%. Applicant further discloses on page 12, paragraph 33, in the specification that in an alternate embodiment, a polymer matrix can be filled with a fusible material only, and the weight percentage of the fusible material is 60-95%. In claim 11, applicant is claiming the fusible material is 60-90% weight in the embodiment which the filler is a non-fusible core coated with fusible material. It appears to the examiner that the weight 60-90% of the fusible material is too high to use because in this embodiment, the fusible serves as a coating material only.

In response, applicants respectfully submit that claim 11 does not include the limitation of the fusible filler serving as a coating material (see paragraph 27). Additionally, because the non-fusible core can be as small as "a powder," the claimed percentage weight of the fusible filler as 60 – 90% of the total weight of the thermal interface material is not only possible, but advantageous. Moreover, the claimed percentage weight range is consistent with the disclosed percentage weight range of all filler relative to the weight of the TIM in conjunction with the disclosed percentage volume range of fusible filler to non-fusible filler for the materials suggested as fusible and non-fusible fillers.

Specification

The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter.

In response, applicants have amended the specification in regard to claim 12, cancelled claim 28, and have amended claim 10. In regard to claim 12, applicants respectfully submit that support for the amendment to the specification is found in the specification, the drawings, and in the claims as originally filed.

Rejections Under 35 U.S.C. § 112

The Examiner has rejected claims 12 and 28 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The Examiner has stated that

> As regarding claim 12, the claimed subject matter of "the non-fusible particles are in a range of approximately 5-49% by weight" is not described in the specification.
>
> As regarding claim 28, the claimed subject matter of "the thermal interface material is non-adhesive" is not supported by the original disclosure. The original disclosure only describes in claim 7 and page 5, paragraph 11, in the specification that the binder material acts as an adhesive and there are no description of any material of the thermal interface material that make it non-adhesive.

(pg. 3, Office Action 1/15/04)

In response, applicants have amended the specification and cancelled claim 28.

Rejections Under 35 U.S.C. 102(a)

Claims 1, 6, 9-11 and 19 stand rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent No. 6,207,300 , of Koch, et al. ("Koch"). The Examiner states

> "Koch discloses (column 2, lines 33-42 and column 4, lines 38-49) a thermal interface material comprising a polymeric binder material; a fusible filler (nickel-base solder)

randomly positioned with respect to the binder material; a plurality non-fusible particles (pulverulent alloy of nickel) which has higher melting temperature than the fusible filler, randomly positioned with respect to the binder material…"

(pg. 4, Office Action 1/15/04)

Koch discloses

It has now been found that these requirements are fulfilled by a screen-printable solder paste which, in an organic binder system, contains 80 to 95 wt. % of a mixture of a nickel-based solder and a pulverulent alloy of nickel with one of the elements chromium, molybdenum, tungsten, manganese or iron as a higher-melting metallic filler, and which is characterised in that the weight ratio of solder to filler is 2-6:1, the average grain size of the solder is between 10 and 50 .mu.m and the grain size ratio, relative to the average grain size, of solder to filler is 0.5-2.5:1.

(Koch, col. 2, lines 33-42)

144 g of nickel-based solder L-Ni2 of the alloy composition Ni82.4Cr7Fe3Si4.5B3.1 having an average grain size of 35 .mu.m are homogenised for 30 minutes in a tumble mixer with 36 g of Ni80Cr20 filler powder having an average grain size of 17 .mu.m. The solder/filler mixing ratio is 4.0:1, the solder/filler grain size ratio is 2.0:1. The powder mixture is then vigorously stirred in a high-speed stirrer at 3000 rpm into 20 g of a binder consisting of 15% polyisobutylene, 1% thixotroping agent (Crayvallac SF), remainder light naphtha. Stirring is continued for a further 30 minutes to complete the dispersion. After cooling to room temperature, the viscosity is adjusted to 30 Pa.s by adding a thinner.

(Koch, col. 4, lines 38-49)

Applicants respectfully submit that claim 1, as amended, is not anticipated by Koch under 35 U.S.C. 102§(a). Amended claim 1 includes the following limitations:

A thermal interface material, comprising:
a binder material;
a fusible filler within the binder material, the fusible filler randomly positioned with respect to the binder material; and
a plurality of non-fusible particles having a mean diameter of approximately 25 microns, within the binder material, the non-fusible particles randomly positioned with respect to the binder material, the fusible filler coated onto a portion of the non-fusible particles wherein a volume percent of the fusible filler to non-fusible particles is in a range of approximately 10 – 50 volume % fusible filler.

(Amended claim 1) (emphasis added)

Applicants respectfully submit that Koch does not disclose the limitation of the fusible filler coating a portion of the non-fusible particles. For this reason, applicants respectfully submit that claim 1, as amended, is not anticipated by Koch. Given that claims 6, 9-11, and 19 depend from claim 1, applicants respectfully submit that claims 6, 9-11, and 19 are, likewise, not anticipated by Koch.

Rejections Under 35 U.S.C. 102(b)

Claims 30 and 31 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,114,413 , of Kang, et al. ("Kang").

In response, applicants have cancelled claims 30 and 31.

Rejections Under 35 U.S.C. § 103(a)

Claims 1, 3, 5-10, 15-17, 19 and 26-27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,114,413 of Kang, et al. ("Kang") in view of U.S. Patent No. 4,869,954 of Squitieri ("Squitieri"). The Examiner states

> "Kang discloses (figures 1-3, 5, column 2, lines 59-63 and column 4, lines 28-36) that a thermal interface material comprising a polymer paste material (polymer) acts as an adhesive; a fusible filler (Sn) coated onto a plurality of non-fusible particles (Cu) which has a sphere shape or a non-uniformly shape; and the pre-coated non-fusible particles randomly positioned within the binder material..."
>
> "Squitieri discloses (column 3, line 66 – column 4, line 28) a thermal interface materials having conductive fillers embedded within a binder, wherein the conductive fillers has a particle size from 1 micron to about 50 microns so as not to distort the surface of the thermal interface material..."

(pg. 5-6, Office Action 1/15/04)

Kang discloses

FIG. 2 illustrates a thermally conductive paste (TCP) material 30, according to the present invention, comprising particles 34 having a thermally conducting coating 32, as conducting filler materials, and a polymer matrix 36. Particles 34 are preferably Cu particles. Any powder material with a high thermal conductivity, such as diamond, aluminum nitride, etc., coated with metals such as Cu, Ni or Pd can also be used instead of copper.

(Kang, Col. 2, lines 59-63)

an optimized formulation for the thermal via or thermal plug application, comprising tin-coated copper powder of 30 to 90% in weight, polyimide siloxane, NMP solvent, and butyric acid and ethylene glycol or no-clean flux.

high conductivity powder materials such as diamond, aluminum nitride, boron nitride, etc., coated with metals such as Cu, Ni or Pd, and coated with low melting point metals such as Sn, In, Bi, Sb, and others, mixed with an environmentally-safe fluxing agent, and polymer resins.

(Kang, Col. 6, lines 39-49)

Squitieri discloses

Fillers suitable for use in the present invention are particulate solids capable of providing the urethane binder with the desired thermal conductivity. Preferably, these fillers are particulate solids which are electrically insulative as well as thermally conductive.

Examples of such particles include but are not limited to aluminum oxide, aluminum nitride, boron nitride, magnesium oxide and zinc oxide. If the material does not need to be electrically insulative, the fillers may include various thermally conductive metals such as silver, gold and copper or metal coated materials, such as silver coated glass, silver coated copper or silver coated aluminum.

The particles should be of a sufficiently small size so as to not distort the surface of the thermally conductive material. Preferably the filler will be of a size from about 1 micron to about 50 microns, more preferably in a range of from abut 5 microns to about 25 microns, most preferably about 10 microns.

The fillers are to be included in the urethane binder in an amount sufficient to provide the desired thermoconductivity. Preferably, the fillers are included in amount of from about 10% by weight to about 85% by weight of the finished product. More preferably, the fillers are included in amounts ranging from about 40% by weight to about 75% by weight and most preferably about 68% by weight.

> The more preferred fillers are boron nitride, magnesium oxide and aluminum oxide with boron nitride being the most preferred filler.

(Squitieri, Col. 3, line 66 – Col. 4, line 28)

Applicants respectfully submit, however, that claims 1, 3, 5-10, 15-17, 19 and 26-27 are not obvious under 35 U.S.C. § 103(a) in view of Kang and Squitieri.

Kang discloses an optimal powder size of 5-7 microns with a coating with a size distribution of 2-8 microns. Kang further discloses a coating thickness of 0.3 – 0.5 microns. Such dimensions are incompatible with the teachings of Squitieri, which discloses a particle size ranging from 1 - 50 microns.

The particles of Squitieri are not coated, but if they were coated as described in Kang, the relative weights and volumes of fusible filler to non-fusible filler would be vastly disparate from the values disclosed in Kang or the values as claimed. For example, a 1 micron particle having a 0.3 micron coating would have a greater volume of coating than volume of particle. Such values would defeat the purpose of the particle in Kang which is to take advantage of the thermal conductivity of the particle. Likewise, a 50 micron particle having a 0.5 micron coating would have a relatively small volume of coating compared to the particle volume. Such values would defeat the purpose of the coating in Kang, which is a metallurgical bonding (i.e., a Sn-to-Sn bonding at the particle-to-particle interface). Even at the point of interest, that is 25 microns, the purpose of Kang is defeated for a coating as disclosed in Kang.

Therefore, the teachings of Kang and Squitieri are incompatible with one another and there can exist no motivation to combine such teachings.

For these reasons, applicants respectfully submit that claims 1, 3, 5-10, 15-17, 19 and 26-27 are not rendered obvious by Kang and Squitieri, alone or in combination.

Claims 13 and 14 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,114,413 of Kang, et al. ("Kang") and U.S. Patent No. 4,869,954 of Squitieri ("Squitieri") and applied to claim 1 and 3 above, and further in view of U.S. Patent No. 6,365,973 of Koning ("Koning").

Applicants respectfully submit, however, that the combination of Konig does not cure the defect discussed above in reference to the combination of Kang and Squitieri. Applicants respectfully submit, therefore, that claim 13 is not rendered obvious by the combination of Kang, Squitieri, and Konig.

It is respectfully submitted that in view of the amendments and arguments set forth herein, the applicable rejections and objections have been overcome. If there are any additional charges, please charge Deposit Account No. 02-2666 for any fee deficiency that may be due.

Respectfully submitted,

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